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The Regulation of the Composition of the Blood of Teleost and Elasmobranch Fishes, and the Evolution of the Vertebrate Kidney[1]

By Homer W. Smith

I

WE ordinarily think of the kidneys as the essential organs involved in regulating the composition of the blood. This is true of the mammals, but it is not true of the lower vertebrates because the kidney at the lower stages of its evolution is incapable of performing the essential operation of *hypertonic excretion*. The evolution of body fluid regulation is intimately tied up with this problem of hypertonic excretion.

The osmotic problem faced by a fish when it lives in fresh or salt water can be briefly stated as follows:

In fresh water the organism by virtue of the salt content of its blood and tissues, is osmotically superior to its environment, and in consequence of this fact, water tends to pass from the external medium into the body and at the same time salts tend to escape from the body outward. In order to maintain a constant composition with respect to water, etc., such an organism must compensate for this continuous dilution by excreting from its body a solution (urine or otherwise) which is *more dilute than its blood*. We will find it convenient to refer to this physiological operation as *hypotonic excretion*.

In salt water the situation is reversed, and water tends to move out of the body and salts to enter. In order to compensate for this continuous "concentrating" effect the organism must excrete from its body a solution which is *more concentrated* than its blood. This process we will designate as *hypertonic excretion*.

We actually find a wide separation in these two processes in the vertebrate kidney, the capacity to excrete a *hypotonic* urine greatly antedating the capacity to excrete a *hypertonic* urine. In the elasmobranchs, the teleosts, the amphibia, the reptiles and the birds the urine is usually hypotonic to the blood, and never more than isotonic. It is not until we come to the mammals that a hypertonic urine is observed; in these the urine may have from 5 to 12 times the osmotic pressure of the blood. This hypertonic excretion is possibly due to the loop of Henle in the renal tubules, which first appears in the bird kidney and is strikingly developed in the mammalian kidney.

In the absence of the capacity to excrete a hypertonic urine, the marine fish is required to separate water from the osmotically concentrated sea water in which it lives, in order that it may have the water necessary for urine formation. The teleosts and elasmobranchs have solved this osmotic problem in two different ways.

The teleost "drinks" sea water and absorbs the water and most of the salts from the gastrointestinal tract. The salts it excretes for the most

[1] Paper read at the 1931 meeting of the Society.

part extrarenally (that is, by the gills) and thus leaves water osmotically free for the formation of urine in compliance with the osmotic limitations of its kidneys (Smith, 1930).

Through the favor of the John Simon Guggenheim Memorial Foundation we have recently had the opportunity to examine the water and salt cycle in certain fresh water elasmobranchs of Siam and Malaya. By combining this information with work which we have done over the past five years at Salisbury Cove, Maine, and at the New York Aquarium on marine forms, it is possible to define the osmotic regulation of this interesting Order.

The elasmobranch shares with the teleost both the capacity to excrete a hypotonic urine and the capacity to excrete salts extrarenally; but it has added to, or exaggerated, a mechanism that is not observed in the teleosts. The kidney of the elasmobranch conserves urea (which is in them an end product of protein combustion as in other vertebrates) by reabsorbing this substance from the urine. The gills of these fishes are relatively impermeable to urea, so that between renal conservation at one end and branchial impermeability at the other, a natural uremia results, the urea concentration of the blood rising to as much as 2.5 per cent. The presence of this urea increases the osmotic pressure of the blood to values actually above that of the sea water in which the animal lives; and by virtue of this osmotic superiority it is enabled to absorb water directly from sea water to the partial or complete exclusion of salts. This absorption of water probably occurs through the gill membranes. In other words, the elasmobranch puts itself back, by this urea mechanism, into the same relative osmotic position as characterizes a fish in fresh water. It does not need to drink sea water, because the urea enables the organism to absorb water directly. Thus the kidneys, by regulating the urea level of the blood, simultaneously control the water intake and the water content of the body, and hence the rate of urine formation. Where the marine teleost obtains water for the formation of hypotonic urine by drinking sea water and excreting the salts extrarenally, the elasmobranch does the same trick by saving its urea and elevating the osmotic pressure of its blood.

The extrarenal excretion of salt, so important in the marine teleost, is an active process in the fresh water teleost as well, and even in the marine and fresh water elasmobranch, although in the latter it plays a subordinate role to the urea. It is apparently a very archaic mode of body fluid regulation and may be directly inherited from an invertebrate ancestor, for as Schlieper (1930) has recently shown, osmotic regulation among invertebrates is effected by extrarenal means. In the fishes we believe that this extrarenal excretion is carried out by the gills, perhaps by special cells or perhaps by the flat epithelium itself.[2]

It is interesting that both the teleosts (Smith, 1929) and the elasmobranchs excrete most of their area by the gills, but this is purely a diffusion process apparently, and of no importance in the maintenance of water equilibrium. The fact that urea is constantly diffusing through the elas-

[2] The branchial excretion of salts by the gills of Anguilla in salt water has been recently demonstrated by Keys (1931).

mobranch gill, in spite of its low permeability, is not significant either; it simply means that no tissue is *absolutely* impermeable to urea, and it only requires a more complete conservation of this substance on the part of the kidneys.

The essential feature of body fluid regulation, as we see it, is the maintenance of a relatively constant water content in the body. The organism is indifferent to the actual amount of urea or the actual osmotic pressure, except as these play a part in the water exchange. It happens in the teleost, where the urea mechanism is not used, that the salts of the blood and body fluid are simultaneously regulated within narrow limits of concentration, and this fact leads to a constant osmotic pressure. But when we note that the elasmobranch also regulates its water and salt content to within narrow limits as does the teleost, but allows the osmotic pressure to vary, we are led to doubt if the osmotic pressure *per se* is a "steady state" of any physiological significance. We see it, rather, as a state which in the teleosts is steady only because the two variables upon which it depends—namely water content and salt content—are themselves regulated to constancy.

In brief summary, then, the fact that the fish kidney is physiologically limited to hypotonic excretion requires that the marine fish either:

a) Drink sea water and excrete the salts one place and the water as urine—this is the way the teleost does it; or

b) Raise the osmotic pressure of its blood to a level above the sea water and absorb water directly—this is the way the elasmobranch does it, and it uses for this purpose a substance which in other animals is merely a waste product. Thus are old things put to new uses.

II

In a recent paper Marshall and Smith (1930) have formulated a theory of the evolution of the vertebrate kidney, based upon the embryology and physiology of this organ.

Briefly, this theory supposes that the remote vertebrate ancestor possessed a tubular kidney draining the body coelom, such as is observed in most invertebrates, and especially in the annelids. The glomerulus, which is found only in the vertebrate kidney, is supposed to have been evolved by some primitive chordate to facilitate the excretion of water from the body. This postulate rests in part upon the currently accepted views of kidney function, and in part upon the palaeontological evidence that the earliest definitive fishes were inhabitants of fresh water. The first glomerular forms, it should be noted, may well have been highly organized vertebrates; the postulate does not require, as Chamberlain has suggested, that the first chordates themselves were evolved in fresh water, but only that the special character of the glomerular kidney indicates a fresh water habitat at the time when this character was established.

So long as the organism remained in fresh water (dipnoans, ganoids and teleosts) or in intimate dependence upon it (Amphibia), this excretory arrangement persisted; but with the secondary assumption of a marine habitat (teleosts) where the osmotic gradient was reversed and the water

excretion reduced, or with the assumption of terrestrial life in which water conservation became a necessity (arid-living reptiles and birds), the organism no longer needed and could no longer economically use this primitive water-excreting mechanism. There was thus a need to either (a) discard or reduce the glomeruli or (b) amend their primitive function by adding distally a more efficient mechanism for the reabsorption of water. The first process appears to be occurring in the marine teleosts and in the reptiles. In the mammals and possibly to some extent in the birds, on the other hand, the addition of the loop of Henle has permitted the reabsorption of water against the osmotic pressure of the metabolites in the urine; consequently in these the glomeruli, although still very active as filters, have become secondarily incorporated into a filtration-reabsorption system which permits the excretion of waste products without the excretion of excessive quantities of water.

In substantiation of this theory it is to be noted that the glomeruli of the birds are apparently undergoing degeneration, for in the adult they contain a large core of embryonic tissue.

In the reptiles the glomeruli are degenerating in another manner; in the adult the capillary tuft is largely replaced by connective (?) tissue.

But the fate of the glomeruli is most striking in the *marine fishes,* in which the excretion of water is greatly reduced.

Fresh water fishes have typically numerous and well developed glomeruli which contain many branched capillaries. (For quantitative determinations of glomerular development in fish see Nash, 1931; further unpublished data from the East Indies are included here). Central euryhaline families such as the perch, show a moderate reduction in size and number of glomeruli. This process of glomerular reduction is not perceptibly furthered in the Labroidei; but a marked reduction is shown in the Scorpaenoidei where the glomeruli are typically large but few in number; and in the Plectognathi where the glomeruli are typically numerous but *very small. Acanthurus hepatus,* for example, has the smallest glomerulus on record, and *Gobius* shows extensive connective tissue infiltration, in addition to a small number.

The extreme of this reduction process is found in a few of the terminal groups in fish evolution.

Among the Blennioidei, for example, *Salarias faciatus* has very few, very small glomeruli, and in the Hoplodoci and Pediculati (*Opsanus, Batrachus, Lophius* and *Histrio*), the glomeruli have completely disappeared, the kidney remaining a *purely tubular one.*

In the Hemibranchii, *Amphisile* has only a few small glomeruli and all the Syngnathidae so far examined (10 species) are aglomerular. This aglomerular condition persists in the fresh water pipe fish, *Microphis boaja,* indicating that the structure of the kidney is a true evolutionary character, and not a somatic adaptation; once gone, the glomeruli cannot be regained.

Other aglomerular families include the Gobiesocidae and the Saccopharyngidae.

The disappearance of glomeruli will, according to our interpretation,

be influenced by the anadromous or stenohaline habits of a fish, and it is therefore very difficult to establish a close correlation between glomerular development and life habit. Like all evolutionary specializations, this change probably proceeds slowly and a palaeontological history may be required to interpret the present status of any one species.

But it is especially interesting to connect this problem with that of the regulation of the body fluids. It is difficult to interpret either on any hypothesis other than that the vertebrate kidney was evolved to its present status while the organism was living in fresh water.

We can construct a syllogism as follows:

For our major premise, we can begin with the evolutionary principle that functional adaptation corresponds to habitat; and we may add as a minor premise, the physiological fact that the vertebrate kidney, from the elasmobranch to the reptile, is functionally sufficient to care for the organism in fresh water, but functionally deficient in salt water or on land (except as it is further modified in the mammals).

Therefore: the kidney must have acquired its functional nature in fresh water, rather than in salt water or on land.

This deduction would fall if it could be shown that the Palaeozoic seas, contemporary with the fixation of function in the kidney, were more dilute than the blood of the Palaeozoic vertebrates.

Or we might construct a second syllogism, using the same major premise as above, but adding:

The elasmobranch approaches the teleost in respect to the composition and mode of regulation of the body fluids, when both are in fresh water, but these forms acquire a different composition and a different mode of regulation of the body fluids when in sea water.

Therefore: both must have a common fresh water history at some remote and predefinitive stage.

Or we might construct a third syllogism, again using for our major premise an evolutionary principle that morphological adaptation corresponds to habitat; and as our minor premise the fact that the renal glomerulus is best developed in fresh water teleosts and amphibia, and tends to degenerate in the reptiles and birds, and to undergo complete extinction in the highly specialized marine fishes;

Therefore: the glomerular kidney was evolved in fresh water; and—

Since the elasmobranchs and cyclostomes possess a glomerular kidney (though somewhat modified) along with the teleosts: all three major groups of fish-like vertebrates were derived from a common fresh water ancestor.

The validity of these last two deductions, like the first, hinges upon the probable salinity of the Palaezoic seas; but, to some extent at least, so does the whole question of the alleged "fresh water habitat" of the Palaeozoic Fishes.

But it would seem that the physiology of body fluid regulation and the morphology of the kidnye are approaching a point where they can make an independent contribution to this interesting question.

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On the Genera *Paralepis* and *Lestidium* and the Taxonomic Status of Some of Their Species

By A. E. PARR

THROUGH the exhaustive report on "The North Atlantic and the Mediterranean Species of the Genus *Paralepis* Cuv." recently published by Ege,[1] our knowledge of the heretofore very obscure taxonomic relationships of the many forms embraced by this genus has been brought a long step forward toward a better understanding. Since the collections examined by him were especially rich in juvenile specimens, Dr. Ege's identifications of these early stages with the proper adult forms are particularly valuable for the elucidation of the taxonomic and nomenclatural problems evolved from the earlier literature, and many significant changes have been caused by his discoveries. In a few instances, where the suggestions made by Dr. Ege touch opon forms previously dealt with by the present writer,[2] some comments and additional descriptive details and corrections may be in their place, as a supplement to Dr. Ege's comprehensive treatise; and in one case a question of more general interest, involving the taxonomic status of the entire "genus" *Lestidium*, and of its several species, arises from the observations made by Ege on the ontogenetic development of the young of *Paralepis*.

The genus *Lestidium* was introduced by Gilbert in 1905[3] (p. 607), as being "like *Sudis*, but the skin wholly naked, except for a series of small scales along course of lateral line, which are wholly imbedded and concealed beneath the skin." The rest of the generic definition rendered by the said author was essentially in the nature of a general, but not differential, diagnosis. An attempt at a further elaboration of generic dis-

[1] Rep. Danish Oceanogr. Exp. 1908-1910, 2 (A 13), Copenhagen, 1930.
[2] A. E. Parr: Deepsea Fishes of the Order Iniomi, etc. Bull. Bingham Oceanogr. Coll., 3 (3), 1928.
A Contribution to the Osteology and Classification of the Orders Iniomi and Xenoberyces. Occ. Pap. Bingham Oceanogr. Coll., 2, 1929.
[3] The Deep-sea Fishes. Aquatic Resources of the Hawaiian Islands, Sect. 2. Bull. U. S. Fish Comm., 33 (2), 1903 (1905).

tinctions, with the introduction of yet another new genus, *Lestidiops,* was made by Hubbs in 1916,[4] the numbers and arrangement of the lateral line pores being emphasized by this author as diagnostic characters of generic significance. The definition of *Lestidiops,* however, agrees with that of *Lestidium* in the importance placed upon the total nakedness of the skin, but for the lateral line scales, the nakedness of *Lestidiops shyraenopsis* at 230 mm. length being contrasted by Hubbs with the scalyness of *Sudis ringens* Jordan and Gilbert at 6¼ inches (about 160 mm.). In the material previously reported upon by the present writer (1928, loc. cit.), the type specimen of *Paralepis bronsoni* (Parr) was found to have a completely developed squamation already at a length, without caudal fin, of only 64 mm., while another form referred to *Lestidium* under the name of *L. elegans* Parr, was still entirely naked at a length of 173 mm. On the basis of such comparisons as these, there did not, until the time of Dr. Ege's report, seem to be any valid reason for questioning the practical or theoretical justification of a generic distinction between the presumably naked and the scaly forms of the Paralepidinae, and no such question had been raised in the literature. From Dr. Ege's report, however, we now learn that even within the genus *Paralepis* the range of specific variations in regard to the size and ontogenetic stage of development at which the squamation first appears, is so wide that genuine representatives of species known to be scale-bearing in their adult stage, may yet have no trace of scales at a length without caudal fin of as much as 188 mm.[5] On the strength of these findings Ege quite properly refers back to the genus *Paralepis, P. speciosus* Bellotti, for which the present writer had previously introduced a separate subgenus of the genus *Lestidium* in accordance with the scalelessness of all known specimens of this species. With the sentiment that it would be beyond the scope of his investigation Dr. Ege, however, fails to make the next obvious step in the elaboration of his observations, namely to discuss the effect his discoveries necessarily must have upon the taxonomic status of the entire genus *Lestidium* (and *Lestidiops*). A survey of all the recorded specimens of *Lestidium* (and *Lectidiops*) immediately reveals that these do all fall within the same general order of magnitude (173-230 mm.)[6] as the genuine, but still scaleless representative of *Paralepis rissoi rissoi* reported by Dr. Ege (see above), or, in other words, that the scalelessness of the *Lestidium* (and *Lestidiops*) specimens so far known to science fails to be of even specific, much less of generic distinction from true representatives of the genus *Paralepis* of comparable size. Since no other differences of any true significance have so far been shown to exist between the "genera" here considered[7] it seems obvious that a continued failure to consider the various species currently referred to *Lestidium, Lestidiops* and *Paralepis* in conjunction with each other can merely serve to give opportunity for further confusion and

[4] Univ. Calif. Publ. Zool., 16 (13): 155.
[5] "Paralepis rissoi rissoi." See Ege, op. cit., p. 7.
[6] The description of "Lestidium japonicum" Tanaka is not available at this writing.
[7] The apparently greater development of the ventral carina in the naked specimens ("Lestidium" and "Lestidiops") may quite possibly be merely another juvenile feature of these forms ontogenetically correlated with the retarded development of their squamation. The distinctions offered by the characters of the carina are, moreover, too vague to be of any general taxonomic usefulness, when not supported by other features of greater significance.

duplication of descriptions to arise. It is, therefore, herewith suggested that these three genera should now be combined into one, to be designated as *Paralepis* Cuvier,[8] at least so long as practicable generic distinctions have not become re-established on a different morphological basis.

Concerning three of the species referable to this genus *Paralepis,* sensu lato, the writer has the following notes, addenda and corrigenda to make.

1. *Paralepis brevirostris* (Parr)

Lestidium speciosum brevirostis Parr, loc. cit., 1928: 42, fig. 4 (on p. 37).
Paralepis brevirostris Egè, loc. cit., 1930: 53.

The elevation of this form to the rank of a separate species (Ege) makes a few additional descriptive details desirable.

Each premaxillary has a group of 3-5 teeth at the anterior end, the first two being quite small, the following 1-3 larger, although not quite as large as the anterior fangs in the lower jaw, as shown in Fig. 1. The variations in the number of the larger, anterior teeth in the premaxillaries appear to be mainly accidental, the normal number probably being around 5 including the foremost two smaller ones. Behind this anterior group follows a series of 15-18 somewhat smaller, decurved and slightly oblique teeth occupying all the rest of the premaxillaries. Some of these teeth are interspersed with or accompanied by still smaller teeth. There are about 12 teeth in each palatine, the anterior ones somewhat enlarged. Second tooth in lower jaw enlarged, sometimes accompanied by another tooth of the same size, and followed by a series of 15-18 small, straight teeth, not counting the still smaller secondary teeth with which this series is interspersed particularly in its posterior half.

Nine peritoneal pigment sections on one side, ten on the other in the type, dorsal and ventral fins at the sixth to seventh. Sixty-five vertebrae (cotype), the upturned centra at the caudal end being counted as one only. D. 10-11 (9½-10½). A. 23-24 (22½-23½).

Otherwise as described in the original account, the species being morphologically distinguished particularly by its very short snout.

2. *Paralepis bronsoni* (Parr)

Sudis bronsoni Parr, loc. cit., 1928: 36, fig. 3.

This species has by Ege been synonymized with Zugmayr's species, *P. brevis,* but, although a correction must be made of the previously published fin counts of *P. bronsoni,* as already assumed by Ege, a re-examination of the type specimen can merely serve to confirm the measurements given in the original account, by which this species seems to differ quite significantly from the typical representatives of *P. brevis.* Since, furthermore, certain differences also seem to be found in the finer details of dentition, the present writer does not feel convinced that the synonymizing proposed by Ege is justified, but on the contrary must hold that the two forms should be regarded as specifically distinct from each other at least so long as no truly intermediate specimens have been recorded.

In the accompanying table the re-measured proportions of the type of

[8] Ege has adequately shown the distinction of this genus from the genus "Sudis" Rafinesque.

P. bronsoni are compared with the measurements recorded by Ege (loc. cit., p. 55) for the type and for two smaller specimens of *P. brevis.*

TABLE I. COMPARISON OF PARALEPIS BRONSONI WITH P. BREVIS

Species		*P. bronsoni*	*P. brevis*		
Length without caudal fin in mm.		63.5	329.0[1]	83.0	54.5
Length of head	In per	30.0	26.1	27.7	29.5
Length of snout	cent of	15.0	12.5	13.0	14.9
Diameter of eye	length	6.7	4.6	5.8	5.5
Predorsal length	without	63.0	59.3	61.4	60.6
Preventral length	caudal	65.0	60.5	63.3	61.8
Snout to anal	fin	79.5	77.5	78.3	78.0

[1] Type.

According to these figures *P. bronsoni* is particularly distinguished by its relatively large eyes, and also, to a smaller degree, by somewhat greater predorsal and preventral lengths than in *P. brevis.* The vertebrae count (66, the upturned centra being counted as one only) and the corrected fin counts (D. 10½; A. 21½) of *P. bronsoni* are, on the other hand, in good agreement with those recorded for *P. brevis.* While the presence of differences in these counts may give valuable clues for the differentiation of taxonomically separate forms, it should, however, also be kept in mind that the lack of such differences does, on the other hand, not prove the identity of the specimens compared, unless there is agreement in all other morphological characters of taxonomic significance.

In the dentition of the premaxillaries, *P. bronsoni* finally differs most conspicuously from *P. brevis,* as described by Ege. According to Ege, a *P. brevis,* 54.5 mm. long, exclusive of caudal fin, has five fairly large teeth placed close together near the anterior end of its premaxillaries, then *nine*[9] small teeth, curved with the points turned backwards, and from *about the middle*[9] of the premaxillaries *ten*[9] saw-tooth-like teeth which with their long bases crowd up to each other." Another specimen of 83 mm. length, exclusive of the caudal fin is said to differ from the above description in having the number of "small backward curved" teeth in each premaxillary increased to *sixteen,* and behind them another *sixteen saw-tooth-like teeth.* In the very much larger type of *P. brevis,* the premaxillaries are without teeth in front but with about 40 tiny teeth occupying the hindmost two-thirds of each. The type of *P. bronsoni,* however, is intermediate in size between the two smaller specimens described by Ege, being even closest to the smallest one of these, but agrees with Ege's description only in the presence of the anterior 4-6 somewhat larger teeth in each premaxillary (see figure 2). Behind these anterior teeth each premaxillary of *P. bronsoni* has a series of *45 to 50* smaller teeth altogether, of which only the last 7 or 8, occupying less than one-third of the premaxillary length, can be said to be saw-tooth-like in the manner shown in Dr. Ege's illustrations. As will be seen from the above quoted descriptions, the total numbers of small teeth in each premaxillary of Ege's two smaller specimens amounted to only 19 and 32 respectively, between which figures, perhaps more close to the former, the counts for the type of *P. bronsoni* should fall if this specimen were to fit into the same series as

[9] Italics mine.

those in Dr. Ege's material. The dentition on the lower jaw, on the other hand, agrees fairly well with that of *P. brevis* of comparable size, there being a couple of somewhat enlarged teeth in front, on each side, followed by 13-16 medium-sized teeth, mostly arranged in pairs and accompanied by a number of minute teeth situated externally.

So long as no truly intermediate specimens have been found to bridge the gap between *P. bronsoni* and *P. brevis,* in point of the relative size of the eyes and the dentition of the premaxillaries at comparable sizes, the two forms must therefore be provisionally regarded as distinct from each other, although the writer holds no brief for the ultimate validity of *P. bronsoni.*

3. *Paralepis atlanticus* (Borodin)

Lestidium atlanticum Borodin: Fishes. Sci. Res. "Ara" Exp. 1926 to 1928. Bull. Vanderbilt Oceanogr. Mus., 1(1), 1928: 10, pl. 1, fig. 2.

Lestidium elegans Parr: Deepsea Fishes of the Order Iniomi. Sci. Res. Third Oceanogr. Exp. "Pawnee." Bull. Bingham Oceanogr. Coll. 7(3), 1928: 44, fig. 5.

Paralepis thermophilus Ege: The North Atlantic and the Mediterranean species of the genus Paralepis Cuv. Rept. Danish Oceanogr. Exp. 1908-1910, *2*(A 13), 1930: 89, fig. 22-23.

This species was described independently and almost simultaneously by Borodin and by Parr, Borodin's description, however, with priority in regard to imprint date. Considering the genus *Lestidium* beyond the scope of his report, Ege naturally failed to take these earlier descriptions into consideration by the introduction of his new species, *P. thermophilus.* The identity of *P. elegans* with *P. atlanticus* does not leave room for any doubt whatever, and is further confirmed by the fact that the types of both nominal species were obtained within the same general region (The Central American Seas, *P. elegans* at Turks Island, *P. atlanticus* at Jamaica). A comparison with Ege's figures and description, particularly of the "adolescent" stage (43.5 mm. without caudal fin) of *P. thermophilus,* also shows the existence of an excellent agreement in regard to general appearances, proportions and the insertions of the fins between this nominal form, based upon small specimens only, and the larger specimens previously described as *P. elegans* and *P. atlanticus.* X-ray photographs and a partial dissection of the type specimen of *P. elegans* have further given a vertebrae-count (82, the upturned centra counted as one) in perfect accordance with the counts recorded by Ege for *P. thermophilus* (80 to 83). Reexamination has also shown the type of *"P. elegans"* to agree with *P. thermophilus* in the essential features of its dentition (character of teeth in lower jaw) and in the fin counts (D. 10½, A. 29½). To all this may finally be added that the reported distribution of *P. thermophilus* also is concentrated around the region of the Central American seas from which *P. elegans* and *P. atlanticus* were obtained. For these various reasons the present writer is quite confident that it is here a question of one single species only, to be designated as *P. atlanticus* (Borodin). The case may serve as an illustration of the point already taken on page ??, so that it is not practicable at the present stage of our knowledge about these forms to keep the genera *Paralepis* and *Lestidium* distinct from each other. The following

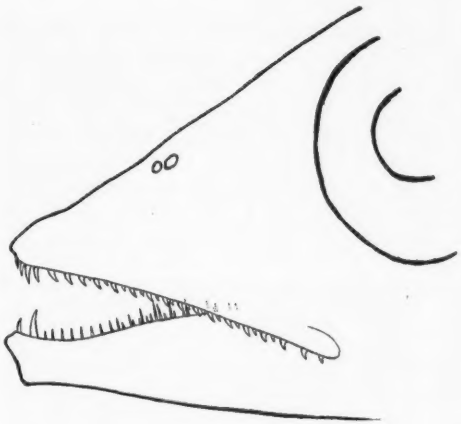

Fig. 1. Dentition of *Paralepis brevirostris.*

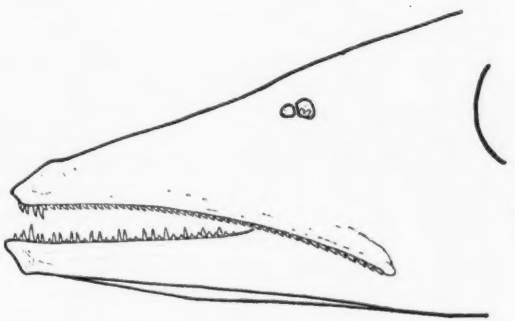

Fig. 2. Dentition of *Paralepis bronsoni.*

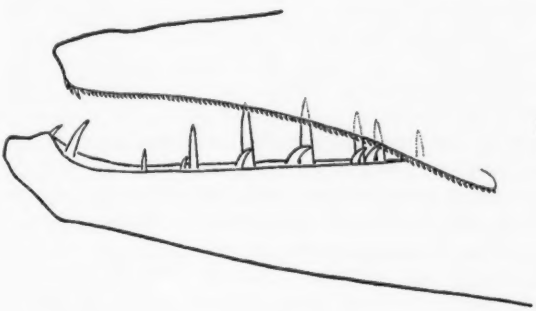

Fig. 3. Dentition of *Paralepis atlanticus.*

details taken from the type of *P. elegans* may serve to supplement the previous descriptions of *P. atlanticus* (Borodin), particularly Ege's description and figures of the younger stages.

Total length 184.5 mm; length without caudal fin, 173 mm.—Proportions in per cent of the length without caudal fin:[10] predorsal length, 59.3; preventral length, 59.8; preanal length [to anus, auth.], 63.5; length to origin of anal fin, 79.0; length of head, 22.5; length of snout, 11.8; diameter of eye, 3.7; length of dorsal fin at base, 4.3; length of anal fin at base, 15.5; distance from anal fin to caudal fin [procurrent caudal rays, auth.], 3.2; distance from anal fin to end of vertebral column, 5.3; distance from adipose fin to caudal fin [procurrent rays, auth.], 4.0; distance from adipose fin to end of vertebral column, 5.1; greatest height of body, 8.5; height at insertion of pectoral fins, 7.5; height at insertion of ventral fins, 7.5; height at foremost ray of anal fin, 6.3; height at hindmost ray of anal fin, 2.4. The proportions show no deviations from those recorded by Ege, which cannot be explained in accordance with the great difference in the size of the specimens compared, Ege's specimen being only one-fourth as long as the type of *P. elegans*.

The dentition of the lower jaw (see figure 3) is essentially the same as the one described by Ege. There is a large, slightly curved tooth near the anterior end of each dentary, preceded by a very small tooth in front. The posterior series in each dentary, beginning after a considerable gap behind these anterior fangs, consists of about 7 teeth, the first one quite small, the following increasing greatly in size so that the length of the third to fourth teeth equals about 12.5 per cent (one-eighth) of the length of the snout. The fifth to seventh teeth are again somewhat smaller. While the teeth just described are almost or entirely straight, they are, with the exception only of the most anterior and the most posterior ones, each accompanied by a much shorter, strongly decurved, exterior tooth. Each premaxillary has three slightly larger and more erect teeth in front followed by 80-85 very small decurved teeth in a closely spaced series. The increase in the number of these premaxillary teeth over the number found by Ege in his much smaller specimen is quite in accordance with similar increases with increasing absolute size reported by Ege for several other species of *Paralepis*. There are 6 large fangs in the anterior portion of each palatine, accompanied by some shorter, strongly decurved teeth, and followed by a series of about one dozen smaller ones.

It is of value to know that this species is still completely scaleless, but for the scales of the lateral line, at a length of at least 173 mm. without caudal fin. Two pores above and two below each lateral line scale in the anterior segments, three in each group in the rest of the series.

BINGHAM OCEANOGRAPHIC FOUNDATION, YALE UNIVERSITY,
NEW HAVEN, CONNECTICUT.

[10] Dr. Ege's designations for the various measurements have been used in the following.

Notes on Two Georgia Species of *Pseudacris*

By Francis Harper

1. *Pseudacris ornata*

On June 9, 1929, I found a small frog hopping about in grassy intermediate pine barrens on Trail Ridge, about 4 miles west of Folkston, Charlton County, Georgia. Through some rather unaccountable *lapsus* I took it at the time for a *Hyla femoralis,* and proceeded to pose it on a near-by pine for a photograph. I recall that it did not cling very well to the vertical trunk, but fell off several times before the photograph (fig. 1) was secured. I must have been at least dimly aware of something unusual about the specimen, for I took occasion to make note of yellow spots on its femora and prominent black blotches on its sides. But evidently I did not notice the absence of digital disks, which would have explained the difficulty experienced in clinging to the trunk. Presently I granted the little creature its liberty as a reward for posing for its photograph.

Fig. 1.—*Pseudacris ornata.* Charlton County, Georgia. June 9, 1929. Approximately life-size.

But when the print from the developed negative came to hand, I finally realized what a rarity had escaped. It was certainly no species previously recorded from the Okefinokee Swamp region. Several months later Dr. Leonhard Stejneger, on the basis of the photograph alone, pronounced the animal either *Pseudacris occidentalis* (Baird and Girard) or *P. ornata* (Holbrook).

These two species are almost suspiciously alike in general geographical distribution, in color pattern, and in rarity, while much remains to be learned concerning their life histories. If the actual color of the lateral blotches, as given in the original descriptions—black for *ornata* (at least on the head), and dark chestnut for *occidentalis*—is constant and diagnostic, then the individual photographed must be referred to *ornata.* Prof. John K. Strecker, of Baylor University, who knows both species in life (1926, and 1929: 11), and to whom I recently sent a copy of the photograph, writes me that it represents a typical *ornata;* also that the lateral blotches in *occidentalis* are dark chestnut (as originally described).

The situation is somewhat complicated by the fact that Noble (1923: 1) has recognized the long disregarded *Chorophilus copii* Boulenger (type locality, Georgia), without stating his grounds for such recognition. Cope himself (1889: 335) synonymized this form with *occidentalis.* With *ornata* and *occidentalis* already occurring in Georgia, it hardly seems likely that there would be room for another form so closely similar to them. It was

evidently through inadvertence that Noble (1923:5) considered *Chorophilus copii* Boulenger, 1882, preoccupied by *Hyla copii* Boulenger, 1887. Therefore *Hyla weberi,* which he proposed as a substitute for the former name, must fall into synonymy.

Cope (1889:337) listed several specimens of *occidentalis* from Georgia (Riceboro and Allapaha), but there seems to be no previous record of *ornata* for the state, though its occurrence was practically certain in view of South Carolina and Florida records. In the apparent absence of any previously published photograph of an adult *ornata,* the present one, which is not far from life-size, may be useful in representing pose, body proportions, and color pattern.

To the best of my recollection, the dorsal ground color of this individual was light brown. Other details brought out by the photograph are: tibia 1.2 times as long as femur; tarsus and fourth toe combined 1.7 times as long as tibia; no more than the faintest suggestion of dorsal blotches; a dark stripe from snout to shoulder, interrupted only by the eye, and bordered below by a conspicuous light stripe; a narrow dark stripe on extreme margin of upper jaw; three lateral and successively smaller black blotches between shoulder and vent; a dark stripe along front of humerus; a dark blotch on elbow; two distinct dark bars on forearm and one on third finger; two faint bars on femur; a series of dark spots on posterior side of tibia, two larger spots on the anterior side, and one on the heel; one or two distinct narrow bars on fourth and fifth toes.

As a common name for this species, "Holbrook's chorus frog" might sound somewhat less bookish than "ornate chorus frog."

2. *Pseudacris nigrita*

This is one of the less common frogs of the Okefinokee region. In fact, it seems to avoid the swamp itself, but has been found on both its eastern and its western borders. My first acquaintance with the species dates from the rainy afternoon of August 5, 1921, when some trills began to be heard from a flooded field of grasses and sedges at Fargo, Georgia. This trilling seemed practically indistinguishable from that of *Pseudacris feriarum* as heard in the vicinity of Washington, D.C., or from that of *P. septentrionalis* of the Athabaska region. One of the singers was located after a considerable search, for it was well hidden in a clump of sedge, with its body half out of the water. Though its back was blackish at this time, it changed, after a couple of days of captivity in a tin can, to olive above, with coarse spots of black. One or two other individuals were heard at the same place.

The notes of *nigrita* were next heard at Hilliard, Florida, during hard rains on the afternoon of August 16, 1922. They came from an individual among some grasses at the side of a rain-filled ditch in pine woods.

Still better opportunities for studying this secretive species came on June 8, 9, and 22, 1929, while I was staying near Spanish Creek, a few miles west of Folkston. One was discovered during the sunny part of the day in grassy intermediate pine barrens, in the same habitat with *Pseudacris ornata.* Others were found in voice in the late afternoon or at night, after hard rains had formed suitable puddles and pools for them

in grassy areas along a highway and a wood road. One of the frogs was on land, several inches from the water, but other calling individuals were observed sitting in shallow little puddles, with just their hind quarters submerged. In several cases the frog was more or less hidden by overarching grass, as it sat almost bolt upright in the calling position. I have heard four or five individuals calling within a radius of a rod or two. The temperature at the periods of vocal activity was within a few degrees of 70.

Each rolling trill consists of about five hard, sharp notes, like the clicks of a wooden rattle, perhaps rising slightly in pitch and emphasis to the end: *ik-ik-ik-ik-ik,* or *rik-ik-ik-ik-ik.* The trill lasts for about 3/5 or 3/4 of a second. Three different individuals called at the following rates: 6 trills in 10 seconds, 10 trills in 20 seconds, and 19 trills in 30 seconds. The rate thus varied from 30 to 38 trills per minute, leaving an average interval of about one second between trills.

During these slight intervals the rounded vocal sac remains partly inflated, about equaling the frog's head in size. Further inflation proceeds rather slowly as the trill is given. The spheroidal, translucent sac reaches its maximum at the end of the trill, when it appears to have a diameter of about three-quarters of an inch, and to be almost the size of the frog's body without its head. The alternate swelling of body and vocal sac is readily visible, as in many other frogs and toads.

This is a rather sedate-looking little amphibian, suggesting the cricket frog (*Acris gryllus*) in general build and in pointed head, but about twice its size. At night its color scarcely bleaches out, as that of *Acris* does. At least one individual appeared rich brown above. The darker spots on the back are generally evident at night, and the light maxillary streak is conspicuous.

I have experienced unusual difficulty in locating trilling individuals, not only because of a certain indefiniteness in the direction and distance of the sound, but also on account of their extreme propensity for becoming silent at the approach of a light. Thus this remains one of only four species, among the twenty tailless amphibians of the Okefinokee region, that have eluded my efforts to secure flashlight photographs of them while engaged in vocal activity.

"Black chorus frog" seems to be as suitable a common name for this species as has yet been proposed.

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SWARTHMORE, PA.

Ichthyological Notes

RARE FISHES FROM OFF NORTH CAROLINA[1]—On April 27th, 1931, in New York I received from the trawler "Beauty of St. Joseph" three rare fishes obtained April 22nd to 24th, 75 to 90 miles southeast of Cape Henry, Virginia, in 28 to 50 fathoms of water, as follows:

1. *Zenopsis ocellatus* (Storer)

A large specimen 197 mm. in standard and 230 mm. in total length. The preorbital outline is longer and more horizontal than figured for this species, and the caudal longer and distinctly emarginate,—characters presumbaly due to its large size. Dorsal VIII, 26; anal III, 25; depth in standard length 1.7; head 2.6; eye in head 4; ventrals 1.3; caudal 1.8.

This capture seems to extend the known range of the species farther south than any previous records known to me. (Bigelow and Welsh, 1925, Fishes of the Gulf of Maine, give a locality off New Jersey.)

2. *Antigonia capros* Lowe

A specimen 91 mm. in standard length. This seems to establish a new northerly record on our coast. Jordan, Evermann and Clark in their 1930 *Check List,* give only Barbados.

3. *Pontinus rathbuni* Goode and Bean

A specimen 129 mm. in standard length, clearly referable to the genus *Pontinus,* is presumably of this form, described from approximately the same locality, although it varies somewhat from the type thereof.

Depth in length, 2.8; head (without opercular flap), 2.6; eye in head, 4; snout in head, 3.2; maxillary in head, 2; width of head, 1.9; depth of peduncle, 4; its length from dorsal axil, 4.7; longest dorsal spine (3rd), 2.1; longest dorsal ray, 2.5; pectoral, 1.6; ventral, 1.7; second anal spine, 2.7; longest anal ray, 2.3; caudal, 1.8; interorbital in eye, 2.4; supraocular tentacle in eye, 1.3.

Dorsal XI, 10; anal III, 5; ventrals I, 5; pectorals, 17. Scales about 30.

First dorsal spine somewhat more than one-third length of 3rd spine, which is appreciably longer than the second anal spine which is somewhat longer than third. Pectoral rays all simple. Caudal subtruncate.

Back irregularly marked with dusky blotches. Soft dorsal and caudal with dark spotting; pectorals with a few spots. General color reddish when fresh, pale in alcohol.

J. T. Nichols of the Department of Ichthyology, American Museum of Natural History, has checked these identifications carefully and rendered other valuable assistance to me in this work.—F. E. Firth, *Harvard Biological Institute, Cambridge, Massachusetts.*

A SUBSTITUTE NAME FOR *DOLICHODON* PARR, A GENUS OF DEEP-SEA FISHES.—Dr. Carl L. Hubbs has called the wirter's attention to the fact that the generic name *Dolichodon,* introduced by me for a new genus of deep-sea fishes in the Bulletin of the Bingham Oceanographic Collection, 2 (4), 1931: 46, is preoccupied by *Dolicodon* Fanzago (I Chilopodi Italiani, Atti Soc. Pad., 3, 1874: 44; spelling corrected to *Dolichodon* by Cambridge in Zoological Record, 1875: 262). A new generic name, **Hemicyclodon,** is therefore now submitted for *Dolichodon* Parr. —A. E. Parr, *Bingham Oceanographic Foundation, Yale University, New Haven. Connecticut.*

[1] Published by permission of the Bureau of Fisheries.

Herpetological Notes

SOME CENTRAL AMERICAN SNAKE GENERA.[1]—Amaral's recent list of Neotropical Snakes (Mem. Instit. Butantan, 4, 1929) lists 80 genera of snakes as occurring between the southern border of the United States and Colombia. Certain additions and corrections to this list seem necessary, and follow.

Sibynophis.—This genus of four species, found from Mexico to Panama inclusive, is omitted from Amaral's list.

Rhinobothryum.—*Rhinobothryum bovalli* Anderssen (Med. Goteborg's Mus. 9, 1916) from Siquirres, Costa Rica, is omitted from Amaral's list, and hence the genus is omitted from Central America.

Adelphicos.—The generic assignment of the various Mexican and Central American snakes usually called *Geophis* or *Atractus* cannot be decided at present. Amaral follows Boulenger's arrangement. *Adelphicos quadrivirgatus* is, however, so different from the rest that it merits quite separate consideration. In any division of the Colubridae it belongs even in a different subfamily from *Atractus.*

Phydrops.—*Phydrops melas* Boulenger (type: B.M.N.H., No. 1905-1-30-53) is a strict synonym of *Amastridium veliferum* Cope. The genus should therefore be omitted from the Central American fauna. It is remarkable that the first four specimens of this rare genus to be collected were each described as a new genus and species, *Amastridium veliferum, Fleischmannia obscura, Phydrops melas,* and *Mimometophon sapperi.* The first three are conspecific, but *sapperi* is a quite distinct species.

Contia.—Amaral includes *Contia* in his list on the basis of *Contia pachyura* Cope (type: U.S.N.M., No. 30618) which was described from Costa Rica in 1875. He also includes *Liophis fulviceps* (type: U.S.N.M., No. 61187) which Cope described from Panama as a *Rhadinaea* in 1886. Since these two specimens are practically identical, and certainly conspecific, *Contia* should be omitted from the Central American list, and *Liophis fulviceps* should stand as *Liophis pachyurus.*

Synchalinus.—This monotypic genus with the species *corallioides,* is based on A.M.N.H., No. 17271. Since this specimen is actually *Phrynonax poecilonotus,* the genus *Synchalinus* should be dropped.

Tropidoclonion.—This genus is included in the Mexican fauna by Amaral on the basis of the species originally described as *Adelophis copei* Dugès, and *Tropidoclonion storerioides* Cope. The latter was long ago transferred to the genus *Natrix* by Cope himself, and there I have no doubt it belongs. The former Cope always considered a distinct genus. It is allied to *Tropidoclonion,* but also to *Thamnophis.* Both *Tropidoclonion lineatum* and *Adelophis copei* are degenerate forms allied to and probably descended from *Thamnophis.* The two differ very considerably, and should be kept in different genera. *Tropidoclonion* should be removed from the Central American list, and *Adelophis* take its place.

Leptodrymus.—Amaral lists *Leptodrymus clarki* Amaral (1927) from Honduras, *Masticophis bitaeniatus* (Boettger) (1898) from Guatemala, and *Masticophis pulcherrimus* (Cope) (1874) from Mexico. I have examined all three types and the three species are identical. I am rather uncertain what this does to the genus *Leptodrymus,* since Amaral apparently considers two specimens of the species to belong in *Masticophis* and a third to belong in *Leptodrymus.* Since Ortenburger refused to include *pulcherrimus* in *Masticophis,* it is quite likely that the genus may be a valid one, containing a single species, *pulcherrimus* Cope, which ranges from Mexico to Nicaragua.—E. R. DUNN, *Haverford College, Haverford, Pennsylvania.*

LACERTA MELISELLENSIS FIUMANA AT PHILADELPHIA.[2]—During the summer of 1927, Mr. Arthur Foehl, Jr., of West Philadelphia, a dealer in animals who is well known for the interesting collections of reptiles and amphibians which he usually has for sale to scientific institutions, had the misfortune to lose a number of European lizards, of the genus *Lacerta,* by their escape from the cage in which they were confined. They made their way to a small stretch of ground, at the rear of

[1] Contributions from the Department of Biology, Haverford College, No. 10.
[2] This paper was presented at the 1931 meeting of the Society.

Mr. Foehl's residence, which slopes downward to the tracks of the Pennsylvania Railroad. In this open space where the heavy growth of high grass afforded ample insect food and protection, the escaped lizards made their home.

Mr. Foehl was able to retrieve a part of his specimens by making a collecting tour of the field. Some small boys of the neighborhood were also known to have found a few. Great was his surprise, however, when the following year he obtained some very young specimens upon the same ground. It was my privilege to observe the latter while they weer in Mr. Foehl's possession.

In the autumn of 1929, further proof of the fact that these lizards were breeding in this new locality was furnished by Mr. Harry Rosenthal, also of Philadelphia, who collected three half grown individuals which he found hiding under rail ties piled nearby. The following record is no later than April third of this year, when the writer, accompanied by Mr. Rosenthal, was fortunate enough to secure two more specimens; one half-grown and the other fully grown. The larger specimen was found running along the ground, probably having been disturbed while basking in the sun of early spring. The small one was found under a flat stone. Inquiries at a lumber-yard situated at one end of the field, revealed that the lizards are very numerous in the piles of lumber during the summer month.

Were it not for the confining city streets which surround this plot of ground, it is probable that these hardy lizards would so firmly establish themselves as to become a permanent part of the reptilian fauna of Pennsylvania. The similarity in climate between this locality and their ancestral Europe, plus an abundance of food, offers a habitat in which they thrive. It it possible, though hardly probable, that the railway may serve as an aid to dispersal to a region less densely populated by human beings. Thus the species might become more widely distributed.

Having no knowledge of the exact source of the original specimens, it is impossible to be definite with regard to the identity of the recently obtained, American-bred, specimens. However, they seem to agree with Boulenger's *Lacerta muralis* var. *fiumana*, described in the first volume of his "Monograph of the Lacertidae." Mertens and Müller, in their check list of European amphibians and reptiles, place this variety under *Lacerta melisellensis fiumana* Werner, the forma typica of which Boulenger considered a variety of *Lacerta muralis*.

This is the second instance of an introduction of a European reptile into America, the other being that of *Hemidactylus turcicus* at Key West, Florida. It is unique in that it necessitates the addition of an hitherto unrepresented family of lizards to our check lists of New World reptiles.—C. F. KAUFFELD, *American Museum of Natural History, New York City.*

RANA TARAHUMARAE, A FROG NEW TO THE UNITED STATES.—On June 18, 1931, near Pena Blanca Springs, Santa Cruz County, Arizona, the writer was fortunate in finding a colony of the Mexican frog, *Rana tarahumarae* Boulenger. A specimen forwarded to the National Museum was kindly examined by Dr. Remington Kellogg, who pronounced it to be that species. Previously, these frogs were reported only from the Tarahumara Mountains, Chihuahua, Mexico. In Arizona, they were found at an elevation of approximately 4,000 feet in a locality only two miles from the international boundary.

The colony was clustered around a series of pot-holes in a canyon, as it was the dry season of the year and no running water could be found in the region. Besides the twenty or so adults seen in these pot-holes, a group of probably half that number was found in an old tumbled-in mine which had filled with water. The resemblance of the adults to *Rana boylii* is very noticeable, but the size is distinctive—the three specimens on hand measuring 81, 91, and 113 mm. (head and body). This likeness is not so well marked in the larvae, which differ from *Rana boylii* mainly in size, as they range up to 106 mm. in length. Other differences in the larvae are darker coloration, larger color blotches, and fairly uniform labial tooth count of 4/3.

At that date only adults and metamorphosing tadpoles could be found. The breeding season is evidently after the heavy summer rains which begin in July.—BERRY CAMPBELL, *138 N. Poppy St., Monrovia, California.*

REVIEWS AND COMMENTS

THE FAUNA OF BRITISH INDIA, INCLUDING CEYLON AND BURMA. REPTILIA AND AMPHIBIA. Vol. 1.—Loricata, Testudines. By Malcolm A. Smith, M. R. C. S. and R. C. P. (London). Taylor and Francis, London, March, 1931.

The appearance of the first reptile volume of the new *Fauna of British India* must be hailed as a herpetological event of the first magnitude. Under the competent hand of the former director of the Raffles Museum, Dr. Malcolm Smith, who is familiar with reptiles and amphibians of the region from personal experience in the field as well as from long and intensive study in the museums of India and England, it promises to become a standard work, the importance and influence of which will rank with that of Günther's *Reptiles of British India* when it was published 67 years ago. We may expect a thoroughly modern work which will be of tremendous help to all interested in the herpetology of Southeastern Asia, or systematic herpetology at large, for that matter. The work is to be in four volumes and the territory embraced includes the entire Indo-Chinese Subregion, consequently a much larger area than Boulenger's *Reptilia and Batrachia* of the previous *Fauna of India*, of which it is the successor, though by no means only a "new edition." In addition, the nomenclature adopted is based on the rules of the International Zoological Code so that we may now hope for a fairly uniform nomenclature of world herpetology.

The first volume embracing the crocodilians and turtles has now appeared and fully comes up to expectations. It is preceded by an admirable concise introduction of 31 pages, with such headings as Nomenclature; History, with brief biographical sketches of the principal collectors and authors who have contributed to the subject of Indian herpetology; Zoogeography, dealing with the origin and relationship of the fauna, and the subregions into which the territory is divided accompanied by a very useful map; and finally miscellaneous remarks pertaining to technique of description and preservation of specimens. There is also a useful glossary of technical terms and a bibliography. A brief chapter on the chief anatomical characters of the reptiles in general precedes the descriptive parts.

In this brief notice no critical analysis of the volume can be attempted. Suffice it to point out that the descriptions and geographical distribution records are ample, and the text well illustrated with many new figures and occasional distributional maps. In addition there are two excellent plates of profile views of heads of thirteen species of turtles showing their distinctive color patterns which deserve particular mention.

Altogether the work is admirable and will serve as a standard for a long time to come. The succeeding volumes are looked forward to with eager expectation.—LEONHARD STEJNEGER, *U. S. National Museum, Washington, D. C.*

SNAKES OF THE WORLD. By Raymond L. Ditmars. The Macmillan Company, New York, 1931, XI+207 pp., 84 pls., $6.00.—Not often does the author of a popular work in the field of science succeed in producing a work satisfactory both to the public and the scientist. The highest praise that need be given to Dr. Ditmar's account of the serpents is that it is not only readable and entertaining but also instructive and authoritative. The very limitations which the author has set himself, far from detracting from the value of the book, actually contribute to its appeal since its perusal will certainly incite in the reader a desire for more information. The meticulous use of the modern classification, and the attention which has been given to habits in the field rather than to those in captivity will appeal to the herpetologist. The lay-reader who is not charmed by the excellent literary style and the beautiful plates will be hard to please. We predict that the book will have a prominent place both on the shelves of the biologist and in the library of the nature lover.—ALEXANDER G. RUTHVEN, *University of Michigan, Ann Arbor, Michigan.*

EDITORIAL NOTES AND NEWS

Obituary—Joan Proctor

MISS Joan Beauchamp Proctor was born in London on August 5, 1897, and died on September 20, 1931, at the age of thirty-four. Despite the fact that most of her life she was an invalid, or semi-invalid, her accomplishments in zoology were varied and notable. From the time she was a small child she had an active interest in reptiles and in 1917, when on account of poor health, she had to give up her plan to go to Cambridge, she became Dr. Boulenger's assistant in the British Museum. After three years Dr. Boulenger retired and Miss Proctor was put in charge of the collections of reptiles and batrachians. During this time she wrote a number of scientific papers on her favorite subject.

In 1923 she worked on the Aquarium then under construction at the London Zoo, chiefly on rockwork and backgrounds for the aquaria, which show true artistic ability. Her greatest monument, however, is the reptile house at the Zoological Society's Garden. This was planned entirely by her, and embodies ideas that have been and will be copied by all future builders. With the assistance of an electrical engineer she worked out a splendid system of lighting and heating the cages. Her mechanical ingenuity shows not only in the structure of the building but in the numerous "gadgets," as she called them, designed for the handling of dangerous reptiles. Her scientific and technical ability was shown in the use of these in doctoring and caring for her pets; while her artistic sense was expressed in the arrangement of the exhibits.

During the last few years she was so ill that her visits to this building of hers became less and less frequent, but she kept in touch with its work by telephone from her sick-room. Specimens would be sent to her and she would identify them and return them with instructions for their care.

With her death nature lovers have lost a sympathetic, intelligent and efficient leader.—WILLIAM M. MANN, *National Zoological Park, Washington, D. C.*

News Items

ALFRED Ehrenreich, a member of our Society, and known for his efforts to further the new industry of shark leather, died on July 16, 1931.

Dr. Evermann's article on "David Starr Jordan, the Man," from the Jordan Anniversary number of COPEIA, was reprinted in the October number of the Indiana University Alumni Quarterly.

The California Academy of Sciences has this month dispatched an expedition for the collection and study of marine life, fishes particularly, in the waters of the west coast of Mexico and Panama, and about Cocos, Malpelo and Galapagos Islands.

Prof. C. L. Turner of Northwestern University and Dr. Myron Gordon of Cornell University are both planning on leaving soon for Mexico, to collect live fishes for genetic research. Both investigators will also preserve specimens for systematic studies.

The American Academy of Arts and Sciences has appropriated a grant to Dr. G. L. Conel, of the Boston University Medical School, to aid in the collecting of eel embryos.

The Bureau of Fisheries has undertaken a study of the migration of fishes, especially of striped bass, in Chesapeake Bay. Dr. John C. Pearson is conducting the investigation.

Mr. S. B. Locke has recently been appointed Conservation Director of the Izaak Walton League of America.

Prof. John O. Snyder, retiring as head of the Zoology Department at Stanford University, has taken charge of the Bureau of Fishculture of the California Division of Fish and Game.

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